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# The ADOS-C: A new outcome measure for autism intervention studies?

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## Introduction

Objective outcome measures for intervention studies for children with autism spectrum conditions are currently limited. The Autism Diagnostic Observation Schedule – Change (ADOS-C<sup>1</sup>) is a detailed observation of social behaviours coded from a videoed interaction between parent and child. While we do not explore the primary purpose of the ADOS-C in how it may be used to track change in a child’s skills over time, we explore the ADOS-C as a possible candidate outcome measure with respect to the following study objectives.

## Study objectives

- Is the ADOS-C reliable to code and straightforward to administer?
- Is the ADOS-C clinically relevant as measured by correlation with ADOS severity scores?
- Is the ADOS-C independent of non-verbal ability and language which have also been used as outcome measures? <sup>2,3</sup>

## Methods

Thirty-three children (mean age=51.4 months, SD=12.5, range=25–71 months; males=26, females=7) were given: **ADOS:** Module 1 (n=24); Module 2 (n=9). All met criteria for autism. Severity scores of Social Affect (SA) and Restricted, Repetitive Behaviours (RBB). **Mullen Scales of Early Learning:** Non-verbal ability – Subscales of Visual Reception and Fine Motor skills. Averaged age equivalent score. **MacArthur Communicative Development Inventory (MCDI):** Language ability – Words produced raw score. **ADOS-C:** The ADOS-C comprises 15 items that are coded twice in two 5 minute video parts. Coded parts were counterbalanced across participants.

- The ADOS-C average score was calculated by summing scores for items 1 – 13 for each part and then averaged.
- The ADOS-C social communication score was calculated by summing scores for items 1 – 8 for each part and then averaged.



## Reliability

Based on 20 video parts

**Intra-rater:** Weighted Kappa range = .49 – 1.00 indicating moderate to perfect agreement.  
**Inter-rater:** Weighted Kappa range = .00 – .65 indicating slight to substantial agreement.

Reliability	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Intra-rater	.60	.81	.96	.65	.87	.73	.62	.94	.85	.87	.49	.67	.72	.70	1.00
Inter-rater	.13	.34	.32	.40	.23	.20	.34	.38	.56	.65	.00	.27	.09	.12	.40

Numbers shown are Weighted Kappas

Whole scale agreement  
Each item scored within one point as agreement: **Intra-rater = 99%** **Inter-rater = 89%**

## Ease of administration

2. Facial Expression Directed to Others  
Coding for this item indicates the range of the directed and undirected facial expressions used by the child for the purpose of communicating affect. Appropriate facial expressions should be coded even if there are also odd expressions.

- Consistently directs a range (at least 3) of appropriate facial expressions toward the adult in order to communicate affect.
- Consistently directs a limited range (at least 2) of appropriate facial expressions toward the adult in order to communicate affect.
- Directs only one appropriate facial expression toward the adult in order to communicate affect but has one or more other facial expressions to convey affect that are undirected (i.e., a child who displays facial expressions of smiling and angry but only directs the smiling to the adult).
- Directs only one appropriate facial expression toward the adult in order to communicate affect and uses no other facial expressions to convey affect (i.e., a child who only smiles and directs at least some of them to someone).
- Does not direct facial expressions, but has one or more facial expressions that are undirected.
- No variation in facial expression.

Name of coder:  
Date of scoring:  
Participant code number:  
Is this Part A or B? (circle one). NB: Part A/B refer to the time sample being watched (0-5/5-10 mins).  
Is this the 1<sup>st</sup> or 2<sup>nd</sup> time viewing the clip? (circle one). NB: 1<sup>st</sup>/2<sup>nd</sup> refer to the order of watching.

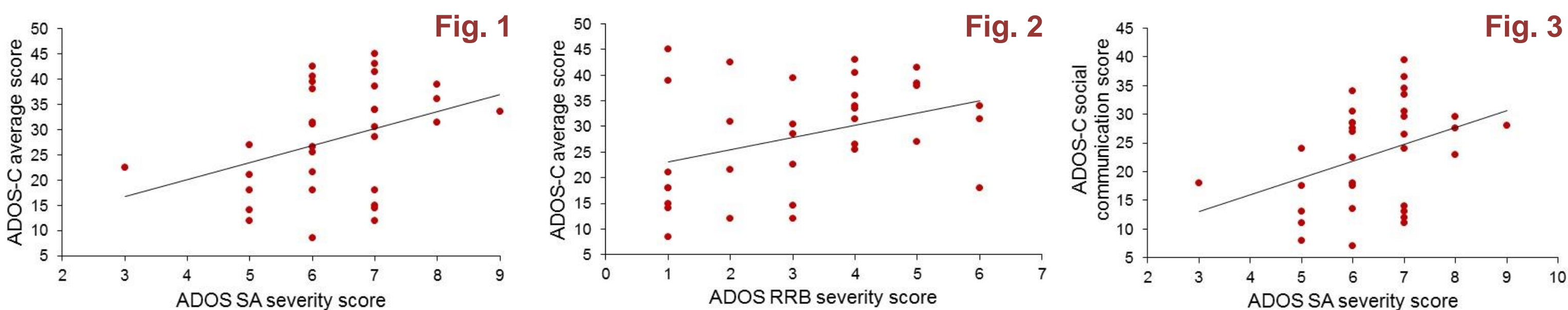
1. Unusual Eye Contact	0	1	2	3	4	5
2. Facial Expression	0	1	2	3	4	5
3. Frequency of Vocalization Directed to Others	0	1	2	3	4	5
4. Integration of Verbal and Nonverbal Modes of Communication during Social Overtures	0	1	2	3	4	5

Fig. 6. Example of ADOS-C item from coding manual

Fig. 7. Example of ADOS-C coding sheet

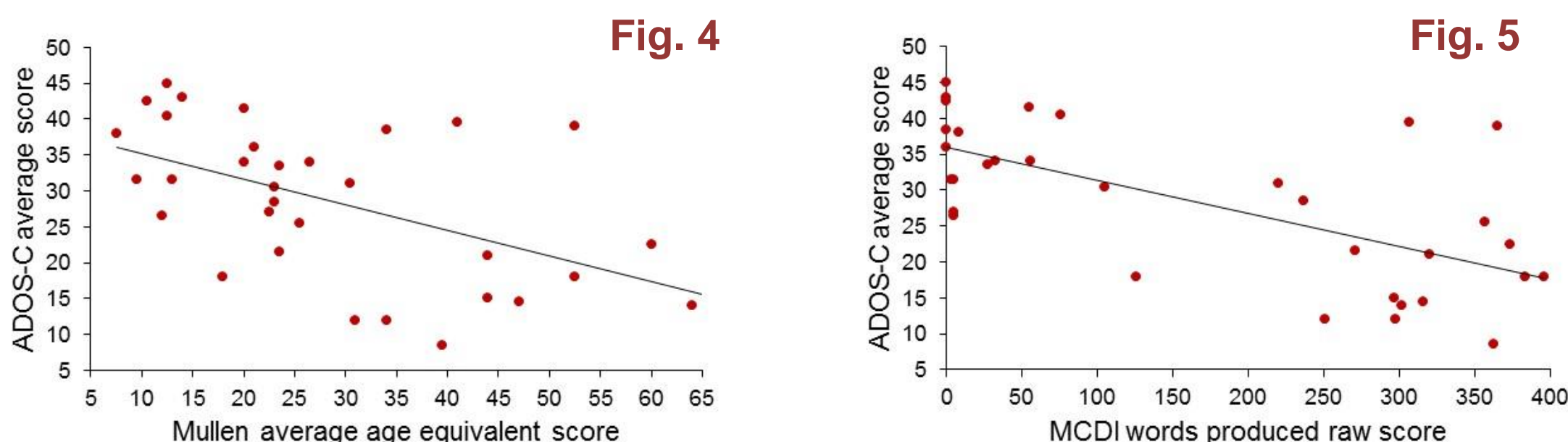
## Clinical relevance

The **ADOS-C** average score correlated positively with the **ADOS** SA severity score ( $r_s=.37$ ,  $p<.05$ ; **Fig. 1**) and the **ADOS** RRB score ( $r_s=.36$ ,  $p<.05$ , **Fig. 2**) to a moderate extent. **ADOS-C** social communication score correlated positively with the **ADOS** SA severity score to a moderate extent ( $r_s=.38$ ,  $p<.05$ , **Fig. 3**).



## Non-verbal ability and language

The **ADOS-C** average score correlated negatively with both the Mullen average age equivalent score to a moderate extent ( $r_s=-.56$ ,  $p<.01$ ; **Fig. 4**) and with the MCDI words produced raw score to a large extent ( $r_s=-.64$ ,  $p<.001$ ; **Fig. 5**).



## Focus on child only

Fig. 8. Examples of various interactions between parent and child



## Discussion

### Reliability and ease of administration

- Whole scale percentage agreements across the ADOS-C were substantial.
- Intra-rater agreement was good at individual ADOS-C item level.
- Poor Kappa ratings for inter-rater agreement may reflect a need for more detailed guidance to raters or a consistent training package for using the measure. Lord and colleagues are developing item score decision trees to improve reliability.
- The ADOS-C is simple and quick to administer and code.

### Clinical relevance

- The strong relationship between the ADOS-C to ADOS severity scores reflects its clinical relevance.

### Independence of non-verbal ability and language

- The ADOS-C is not independent of non-verbal ability and language. This may affect its usefulness as an outcome measure for autism intervention studies.

### Future research

- Explore the sensitivity of the ADOS-C to change with intervention and test-retest reliability.
- Explore how variable or constant children are at any one point in time within a play session with an adult.
- The ADOS-C does not capture parent behaviour – The ADOS-C should be used to capture change in the same parent-child dyads over time; not to compare (for example) two groups of children at a single time point and not to compare the same child with two different adults.

With thanks to all the children and parents who took part and to Professor Lord and colleagues for making the ADOS-C available for our use prior to publication of the measure.

<sup>1</sup> Lord, C., Carr, T., & Gradzinski, R. (2013). Measuring emerging changes in social communication. *International Meeting for Autism Research, San Sebastian, Spain.* <sup>2</sup> Dawson, G., Rogers, S., Munson, J., Smith, M., Winter, J., Greenson, J., Donaldson, A., & Varley, J. (2010). Randomized, controlled trial of an intervention for toddlers with autism: The early start denver model. *Pediatrics*, 125, e17-23. <sup>3</sup> McConachie, H.R.M., Randle, V., Hammal, D., & Le Couteur, A. (2005). A controlled trial of a training course for parents of children with suspected autism spectrum disorder. *Journal of Pediatrics*, 147, 335-340.